WHAT IS CLAIMED IS:

1. An encoder comprising:

an input device for sampling an input signal at predetermined time intervals to obtain sampled data on a temporal axis;

a conversion device for converting the sampled data on the temporal axis to spectral data on a frequency axis;

a quantization device for quantizing the spectral data on the frequency axis; and

an output device for outputting a resultant value of quantization as an encoded bit stream,

wherein the quantization device comprises:

an expected-value-of-quantization adjustment portion for determining an expected value of quantization for a specific sub-band on the frequency axis; and

a quantization portion for determining a quantization coefficient for the specific sub-band, and quantizing each of a plurality of spectral data contained in the specific sub-band using the quantization coefficient for the specific sub-band, and

the quantization coefficient for the specific sub-band is determined so that a resultant value of quantization obtained by quantizing one spectral data selected from the plurality of spectral data contained in the specific sub-band, using the quantization coefficient for the specific sub-band, is substantially equal to the expected value of quantization for the specific sub-band.

2. An encoder according to claim 1,

wherein the quantization portion comprises:

a first quantization portion for obtaining a resultant value of quantization by quantizing the selected

one spectral data;

a quantization coefficient determination portion for determining the quantization coefficient for the specific sub-band; and

a second quantization portion for quantizing each of the plurality of spectral data contained in the specific sub-band, using the quantization coefficient for the specific sub-band,

the quantization coefficient determination portion modifies an initial value of the quantization coefficient by a predetermined amount to obtain at least one quantization coefficient, and compares at least one resultant value of quantization obtained by the first quantization portion using the at least one quantization coefficient with the expected value of quantization for the specific sub-band, and determines a quantization coefficient so that a resultant value of quantization is substantially equal to the expected value of quantization, and

the expected-value-of-quantization adjustment portion adjusts the expected value of quantization for the specific sub-band depending on a number of bits which can be allocated for the encoded bit stream.

3. An encoder according to claim 2, wherein when for a plurality of quantization coefficients, the resultant value of quantization is equal to the expected value of quantization, the quantization coefficient determination portion selects one of the plurality of quantization coefficients so as to obtain a minimum of quantization noise, and determines the selected quantization coefficient as a quantization coefficient for the specific sub-band.

4. An encoder according to claim 3, wherein the

quantization noise is calculated based on a difference between the selected one spectral data contained in the specific sub-band and an inverse quantization value obtained by inversely quantizing the resultant value of quantization.

5. An encoder according to claim 3, wherein the quantization noise is calculated based on a difference between each spectral data contained in the specific sub-band and an inverse quantization value obtained by inversely quantizing a result of quantization of each spectral data in the specific sub-band.

6. An encoder according to claim 2, wherein the selected one spectral data is the largest spectral data contained in the specific sub-band.

7. An encoder according to claim 1,

wherein the quantization portion determines the quantization coefficient for the specific sub-band based on a predetermined relationship among a quantization coefficient, a resultant value of quantization, and an inverse quantization value, and based on the relationship, quantizes each of the plurality of spectral data contained in the specific sub-band using the quantization coefficient for the specific sub-band, and

the quantization coefficient for the specific sub-band is determined so that an inverse quantization value obtained by inversely quantizing the expected value of quantization for the specific sub-band using the quantization coefficient for the specific sub-band is substantially equal to the selected one spectral data.

8. An encoder according to claim 7, wherein the predetermined relationship is defined in a first inverse quantization value table defining a relationship between a quantization coefficient and an inverse quantization value when a resultant value of quantization is predetermined, and a second inverse quantization value table defining a relationship between a resultant value of quantization and an inverse quantization value when a quantization coefficient is predetermined.

9. An encoder according to claim 8, wherein the quantization portion generates, based on the first and second inverse quantization value tables, a relationship between a quantization coefficient and an inverse quantization value when a resultant value of quantization is different from the predetermined resultant value of quantization, or a relationship between a resultant value of quantization and an inverse quantization value when a quantization coefficient is different from the predetermined quantization coefficient.

10. An encoder according to claim 8, wherein an inverse quantization value on the first inverse quantization value table is represented by an inverse of said inverse quantization value.

11. An encoder according to claim 8, wherein an inverse quantization value on the second inverse quantization value table is represented by an inverse of said inverse quantization value.

12. An encoder according to claim 7, wherein the expected-value-of-quantization adjustment portion

determines the expected value of quantization for the specific sub-band based on the plurality of spectral data contained in the specific sub-band.

13. An encoder according to claim 7, wherein the expected-value-of-quantization adjustment portion sets the expected value of quantization for the specific sub-band to a predetermined value.

14. An encoder according to claim 7, wherein the quantization coefficient for the specific sub-band is determined so that an inverse quantization value obtained by inversely quantizing the expected value of quantization for the specific sub-band using the quantization coefficient for the specific sub-band is not smaller than the selected one spectral data.

15. An encoder according to claim 7, wherein the quantization coefficient for the specific sub-band is determined so that an inverse quantization value obtained by inversely quantizing the expected value of quantization for the specific sub-band using the quantization coefficient for the specific sub-band is not greater than the selected one spectral data.

16. An encoder according to claim 7, wherein the quantization coefficient for the specific sub-band is selected from first and second quantization coefficients based on a predetermined condition, an inverse quantization value obtained by inversely quantizing the expected value of quantization for the specific sub-band using the first quantization coefficient for the specific sub-band is not greater than the selected one spectral data, and an inverse

quantization value obtained by inversely quantizing the expected value of quantization for the specific sub-band using the second quantization coefficient for the specific sub-band is not smaller than the selected one spectral data.

17. An encoder comprising:

an input device for sampling an input signal at predetermined time intervals to obtain sampled data on a temporal axis;

a conversion device for converting the sampled data on a temporal axis to spectral data on a frequency axis;

a quantization device for quantizing the spectral data on the frequency axis; and

an output device for outputting a resultant value of quantization as an encoded bit stream,

wherein the quantization device comprises:

a quantization coefficient adjustment portion for determining a quantization coefficient for a specific sub-band on the frequency axis; and

a quantization portion for determining a resultant value of quantization for each of the plurality of spectral data contained in the specific sub-band, based on a predetermined relationship between a quantization coefficient, a resultant value of quantization, and an inverse quantization value.

18. An encoder according to claim 17, wherein the predetermined relationship is defined in a first inverse quantization value table defining a relationship between a quantization coefficient and an inverse quantization value when a resultant value of quantization is predetermined, and a second inverse quantization value table defining a relationship between a resultant value of

quantization and an inverse quantization value when a quantization coefficient is predetermined.

19. An encoder according to claim 18, wherein the quantization portion generates, based on the first and second inverse quantization value tables, a relationship between a quantization coefficient and an inverse quantization value when a resultant value of quantization is different from the predetermined resultant value of quantization, or a relationship between a resultant value of quantization and an inverse quantization value when a quantization coefficient is different from the predetermined quantization coefficient.

20. An encoder according to claim 18, wherein an inverse quantization value on the first inverse quantization value table is represented by an inverse of said inverse quantization value.

21. An encoder according to claim 18, wherein an inverse quantization value on the second inverse quantization value table is represented by an inverse of said inverse quantization value.

22. An encoder according to claim 17, wherein a resultant value of quantization for each of the plurality of spectral data contained in the specific sub-band is determined so that an inverse quantization value obtained by inversely quantizing the resultant value of quantization for each of the plurality of spectral data contained in the specific sub-band, using the quantization cofficient for the specific sub-band, is substantially equal to the each of the plurality of spectral data contained in the specific

sub-band.

23. An encoder according to claim 22, wherein a resultant value of quantization for each of the plurality of spectral data contained in the specific sub-band is determined so that an inverse quantization value obtained by inversely quantizing the resultant value of quantization for each of the plurality of spectral data, using the quantization cofficient for the specific sub-band, is not smaller than the each of the plurality of spectral data.

24. An encoder according to claim 22, wherein a resultant value of quantization for each of the plurality of spectral data contained in the specific sub-band is determined so that an inverse quantization value obtained by inversely quantizing the resultant value of quantization for each of the plurality of spectral data, using the quantization cofficient for the specific sub-band, is not greater than the each of the plurality of spectral data.

25. An encoder according to claim 22, wherein the resultant value of quantization for a specific spectral data of the plurality of spectral data contained in the specific sub-band is selected from first and second resultant values of quantization based on a predetermined condition, an inverse quantization value obtained by inversely quantizing the first resultant value of quantization using the quantization coefficient for the specific sub-band is not greater than the specific spectral data, and an inverse quantization value obtained by inversely quantizing the second resultant value of quantization using the quantization coefficient for the specific sub-band is not smaller than the specific spectral data.

26. An encoder comprising:

an input device for sampling an input signal at predetermined time intervals to obtain sampled data on a temporal axis;

a conversion device for converting the sampled data on the temporal axis to spectral data on a frequency axis;

a quantization device for quantizing the spectral data on the frequency axis; and

an output device for outputting a resultant value of quantization as an encoded bit stream,

wherein the quantization device comprises:

an expected-value-of-quantization adjustment portion for determining an expected value of quantization for a specific sub-band on the frequency axis; and

a first quantization portion for determining an initial value of a quantization coefficient for the specific sub-band, based on a predetermined relationship among a quantization coefficient, a resultant value of quantization, and an inverse quantization value;

a quantization coefficient adjustment portion for determining the quantization coefficient for the specific sub-band; and

a second quantization portion for quantizing each of the plurality of spectral data contained in the sepcific sub-band using the quantization coefficient for the specific sub-band, and

the first quantization portion determines the initial value of the quantization coefficient so that a resultant value of quantization obtained by quantizing one spectral data selected from the plurality of spectral data contained in the specific sub-band, using the initial value for the specific sub-band, is substantially equal to the

expected value of quantization for the specific sub-band, and

the quantization coefficient adjustment portion adjusts the quantization coefficient for the specific sub-band so that quantization noise is not greater than qantization noise which is obtained when each of the plurality of spectral data contained in the specific sub-band is quantized using the initial value.

27. An encoder according to claim 26, wherein the second quantization portion quantizes each of the plurality of spectral data contained in the specific sub-band using the quantization coefficient for the specific sub-band, based on a predetermined relationship among a quantization coefficient, a resultant value of quantization, and an inverse quantization value.

28. An encoder according to claim 26, wherein the predetermined relationship is defined in a first inverse quantization value table defining a relationship between a quantization coefficient and an inverse quantization value when a resultant value of quantization is predetermined, and a second inverse quantization value table defining a relationship between a resultant value of quantization and an inverse quantization value when a quantization coefficient is predetermined.

29. An encoder according to claim 28, wherein the first quantization portion generates, based on the first and second inverse quantization value tables, a relationship between a quantization coefficient and an inverse quantization value when a resultant value of quantization is different from the predetermined resultant value of

quantization, or a relationship between a resultant value of quantization and an inverse quantization value when a quantization coefficient is different from the predetermined quantization coefficient.

30. An encoder according to claim 26, wherein the expected-value-of-quantization adjustment portion determines the expected value of quantization for the specific sub-band based on the plurality of spectral data contained in the specific sub-band.

31. An encoder according to claim 26, wherein the expected-value-of-quantization adjustment portion sets the expected value of quantization for the specific sub-band to a predetermined value.

32. A program for causing a computer to executing an encoding process for outputting an input signal as an encoded bit stream, the encoding process comprising the steps of:

(a) sampling an input signal at predetermined time intervals to obtain sampled data on a temporal axis;

(b) converting the sampled data on the temporal axis to spectral data on a frequency axis;

(c) quantizing the spectral data on the frequency axis; and

(d) outputting a resultant value of quantization as an encoded bit stream,

wherein the step (c) comprises:

(c-1) determining an expected value of quantization for a specific sub-band on the frequency axis; and

(c-2) determining a quantization coefficient for the specific sub-band, and quantizing each of a plurality

of spectral data contained in the specific sub-band using the quantization coefficient for the specific sub-band, and

the step (c-2) comprises the step of determining the quantization coefficient for the specific sub-band so that a resultant value of quantization obtained by quantizing one spectral data selected from the plurality of spectral data contained in the specific sub-band, using the quantization coefficient for the specific sub-band, is substantially equal to the expected value of quantization for the specific sub-band.

33. A computer-readable recording medium for storing an encoding process program for outputting an input signal as an encoded bit stream, the encoding process comprising the steps of:

(a) sampling an input signal at predetermined time intervals to obtain sampled data on a temporal axis;

(b) converting the sampled data on the temporal axis to spectral data on a frequency axis;

(c) quantizing the spectral data on the frequency axis; and

(d) outputting a resultant value of quantization as an encoded bit stream,

wherein the step (c) comprises:

(c-1) determining an expected value of quantization for a specific sub-band on the frequency axis; and

(c-2) determining a quantization coefficient for the specific sub-band, and quantizing each of a plurality of spectral data contained in the specific sub-band using the quantization coefficient for the specific sub-band, and

the step (c-2) comprises the step of determining the quantization coefficient for the specific sub-band so that

a resultant value of quantization obtained by quantizing one spectral data selected from the plurality of spectral data contained in the specific sub-band, using the quantization coefficient for the specific sub-band, is substantially equal to the expected value of quantization for the specific sub-band.

34. A communication device comprising:

a demodulator for obtaining digital audio data by demodulating an input signal;

an encoder for obtaining an encoded bit stream by encoding the digital audio data; and

a recorder for recording the encoded bit stream into a recording medium,

wherein the encoder comprises:

an input device for sampling the digital audio data at predetermined time intervals;

a conversion device for converting the sampled data on the temporal axis to spectral data on the frequency axis;

a quantization device for quantizing the spectral data on the frequency axis; and

an output device for outputting a resultant value of quantization as the encoded bit stream,

wherein the quantization device comprises:

an expected-value-of-quantization adjustment portion for determining an expected value of quantization for a specific sub-band on the frequency axis; and

a quantization portion for determining a quantization coefficient for the specific sub-band, and quantizing each of a plurality of spectral data contained in the specific sub-band using the quantization coefficient for the specific sub-band, and

the quantization coefficient for the specific sub-band is determined so that a resultant value of quantization obtained by quantizing one spectral data selected from the plurality of spectral data contained in the specific sub-band, using the quantization coefficient for the specific sub-band, is substantially equal to the expected value of quantization for the specific sub-band.